Analele Universităţii din Craiova, seria Agricultură – Montanologie – Cadastru (Annals of the University of Craiova - Agriculture, Montanology, Cadastre Series) Vol. XLVII 2017

SOME PROPERTIES OF FREEZE-DRYING WHEY POWDERS

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key words: Whey, freeze-drying, whey powder

ABSTRACT

Whey is the main waste generated in the cheese making process and has high organic matter content and acidity. Beyaz, Kasar and Tulum are the most produced cheese types in Turkey. The whey of these cheeses are treated by freeze-drying to increase quality of whey and provide convenience in both shelf life and transportation. Whey of Beyaz, Kasar and Tulum cheeses were dried for 48 hours under the conditions of 5 mTorr pressure and (-80)°C with freeze dryer in this study. Whey powders were packaged in vacuum with high density polyethylene packages and stored at room temperature then analyzed after 24 hours. According to the results, mean values of the pH, titratable acidity (l.a.%), total solid, fat, protein, ash are as follows. Whey powder obtained from Beyaz cheeses were 5.15 ± 0.30, 1.56 % ± 0.59, 91.70% ± 3.91, 2.00% ± 1.00, 9.30% ± 0.49, 10.67% ± 0.48. Whey powder obtained from Kasar cheeses were 6.14 ± 0.21, 4.71% ± 0.89, 92.95% ± 1.49, 8.60% ± 1.15, 13.28% ± 2.41, 6.69% ± 0.98. Whey powder obtained from Tulum cheeses were 4.88 ± 0.64, 2.91% ± 0.94, 93.08% ± 0.59, 4.88% ± 1.23, 14.33% ± 1.17, 8.80% ± 1.92. In the statistical analyzes, the difference in pH, titratable acidity, fat, protein and ash contents was found to be significant ($p<0.05$), while the differences in total solid values were not significant ($p> 0.05$).

INTRODUCTION

The cheeses that are the most produced in Turkey are White, Kasar and Tulum cheeses (Kamber, 2008). Beyaz Cheese, produced traditionally in almost every part of the country, is the cheese with the highest level of consumption in Turkey. After Beyaz Cheese, Kasar cheese, which is a semi-hard cheese, is the most widely and commercially produced cheese in Turkey. Tulum cheese, a hard type traditional cheese, is the most commonly produced cheese after Beyaz and Kasar cheeses, respectively. Its name, tulum, originates from the goat skin that is traditionally used as a casing material and ripened in it (Kamber, 2008; Say et.al., 2011). The stages in the production of Beyaz cheese, Kasar cheese and Tulum cheese are summarized in Figure 1, 2 and 3. Along with the increase in cheese production, the amount of whey has also increased. Today, large cheese producers have to make use of the whey as a by-product.

Whey is a major by-product which is pre-dominantly generated by dairy industries during the manufacture of cheese (Gajendragadkar, 2016). Although whey differs according to cheese manufacture, corresponds to 85-95% of the milk volume (Geiger et al, 2016). In the word, whey production is about 180-190 ton in a year (Şeker et al.,2017). In 2015, Turkish Statistical Institute (TUIK) data shows that 665,580 tons of cheese are produced in Turkey, while the amount of whey and buttermik is 659,984 tons (Anon., 2015).

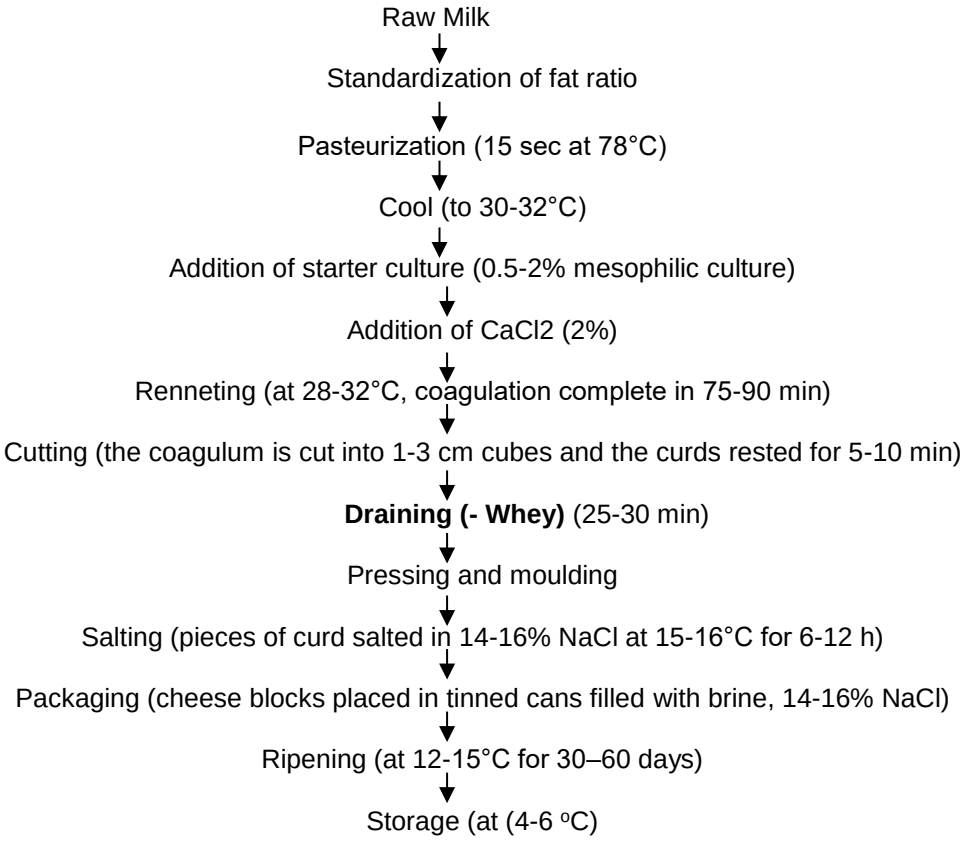

Figure 1. Flow diagram of Beyaz cheese production

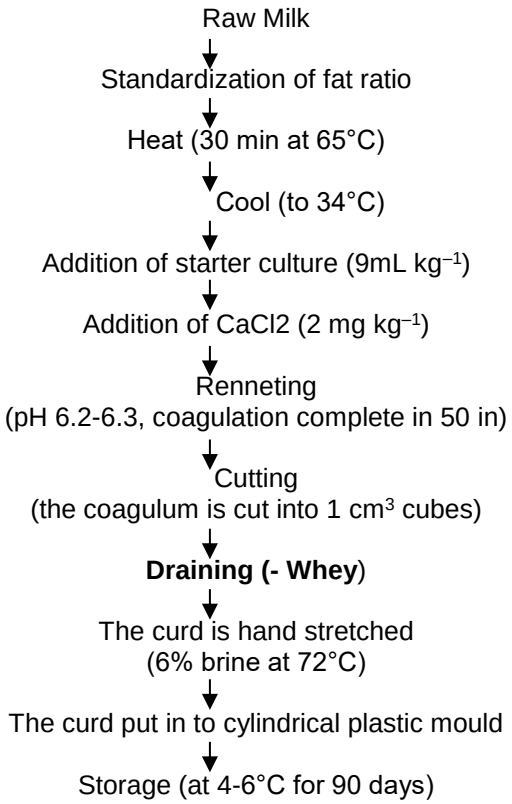

Figure 2. Flow diagram of Kasar cheese production

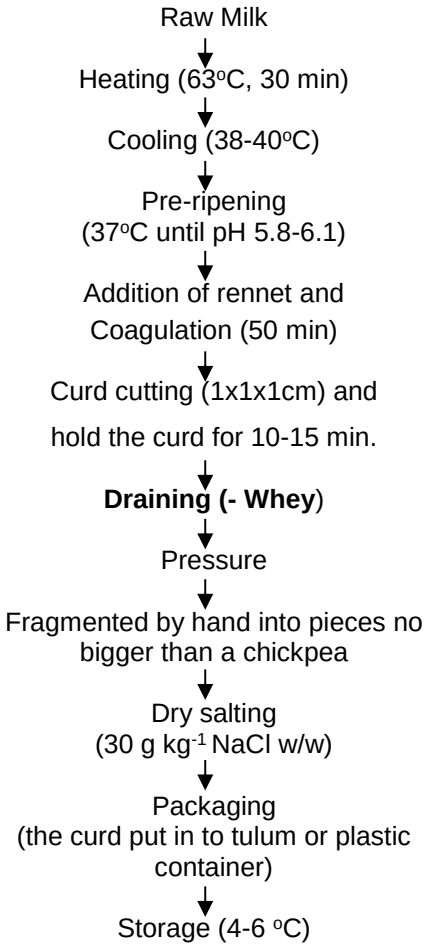

Figure 3. Flow diagram of Tulum cheese production

Whey is classified into two major categories as “sweet whey” and “acid whey”, based on the cheese production process (Nishanthi et al., 2017). Acid whey is a by-product of acid coagulated cheese and has a pH less than or equal to 5.0. Sweet whey is a by-product obtained during the manufacture of rennet coagulated cheese with a pH in the range of 6.0–7.0 (Gajendragadkar, 2016). In both types of whey, water is the major constituent accounting to 90-92% of the total composition and remaining important nutrients include lactose (4–5% w/v), whey proteins (0.6–0.8% w/ v), lipids (0.4–0.5% w/v) with other components like minerals, salts present in minor quantity. So, it can be exploited as a resource of a number of valuable products (Gajendragadkar, 2016; Das et al, 2016).

Almost 50% of the worldwide whey is transformed into value-added products such as whey powder (You et al., 2017). Depending on the removal of the water in the food and the process being carried out at very low temperatures, the final product can be obtained in perfect quality with stopped possible reactions and microbiological activity (Ratti, 2001). Freeze drying is one of the best methods of drying methods in terms of final product quality. A large proportion of whey is freeze-dried to produce whey powder, facilitating storage and transport. In addition, due to its concentrated lactose and other nutrients, whey powder is a more attractive than whey (You et al., 2017) and it is currently used as ingredients in many product formulations (Chandrapala et al, 2017).

The present study aim to investigate the chemical composition of whey powders obtained from Beyaz cheeses, Kasar cheeses and Tulum cheeses through a freeze drying process.

MATERIAL AND METHODS

Materials

Beyaz cheese whey, Kasar cheese whey and Tulum cheese whey were got from Güneydoğu Süt Ltd. Şti., Adana, Turkey. High density polyethylene is used as packaging material for whey powder.

Freeze drying of whey

White, Kasar and Tulum cheeses whey were transported to the laboratory at the Food Engineering Department, Cukurova University, Turkey. The cheeses whey were dried for 48 hours under conditions of 5 mTorr pressure and (-80)ºC with freeze dryer (Ilshin, Holland). Whey powders were packed in vacuum with high density polyethylene packages and stored at room temperature (22^{o}C ± 2^{o}C) and analyzed after 24 hours. Three replicates of whey powders were produced.

Analyses

For pH value, 5 g of whey powder and 15 mL of distilled water were mixed and homogenized in an Ultra Turrax blender (Janke&Kunkel KG, IKA, Werk, Germany). The pH values were measured using a digital pH meter (testo® 230, Testo, GmbH & Co, Germany) (Anon., 1995a). 10 g of whey powder and 10 mL of distilled water were homogenized in an Ultra Turrax blender (Janke&Kunkel KG, IKA, Werk, Germany) and titratable acidity (% lactic acid) were determined by titration using 0.1 N NaOH (Anon., 1995a). Dry matter was determined by drying the samples in an oven at 100 ± 2 °C (IDF, 1982). Fat content was determined according to the Gerber method with cheese butyrometers (Kotterer ve Münch, 1978). Protein was measured by micro-Kjeldahl method (IDF, 1993). Ash content was quantitated by dry ashing the samples in a muffle furnace at 525 ± 25ºC (AOAC, 1998). The results were interpreted using SPSS 18.0 statistical package program in the statistical analysis of whey powder samples (Steel ve Torrie, 1980).

RESULTS AND DISCUSSION

The average compositions of whey powder obtained from Beyaz, Kasar and Tulum cheeses produced by the freeze drying method were given in Table 1.

According to Turkish Standards for whey powder; titratable acidity in terms of lactic acid should be at least 0.19% for sweet whey powder and between 0.20-0.30% for acid whey powder. Ash content of sweet whey powder should be at most 9.50% and that of acid whey powder should be at most 15%. Moisture should be at most 5%, fat content should be at least 2% and protein content should be at least 10% (high-protein), between 4-10% (protein) and at least 4% (low-protein) (Anon., 1995b). The fat, protein and ash content were found to be within acceptable levels.

Table 1

Chemical properties of Whey Powder obtained from Beyaz, Kasar and Tulum cheeses

Properties	***Whey powder of Beyaz***	***Whey powder of Kasar***	***Whey powder of Tulum***
pH	*5.15±0.30*	*6.14± 0.21*	*4.88 ± 0.64*
Titratable acidity (l.a.%)	*1.56 ± 0.59*	*4.71 ±0.89*	*2.91 ± 094*
Dry Matter (%)	*91.70 ± 3.91*	*92.95 ± 1.49*	*93.08 ± 0.59*
Fat (%)	*2.00 ± 1.00*	*8.60 ±1.15*	*4.88 ± .23*
Protein (%)	*9.30 ± 0.49*	*13.28 ± 2.41*	*14.33 ± 1.17*
Ash (%)	*10.67 ± 0.48*	*6.69 ± 0.98*	*8.80 ± 1.92*

As shown in the table, the average values of whey powder of Beyaz, Kasar and Tulum cheeses for pH were 5.15, 6.14 and 4.88, respectively. pH value for Beyaz whey powder was lower than the value reported by Uraz et al. (1990). The mean value obtained in this study was determined to be higher than the value reported by Gülter (2011) for whey powder of Kasar. The differences between the whey powder samples were found to be statistically significant ($p<0.05$).

The titratable acidity values of whey powder of Beyaz, Kasar and Tulum cheeses were found to be 1.56, 4.71 and 2.91, respectively. Titratable acidity value was lower than the findings of Uraz et al. (1990) for Beyaz whey powder sample, higher than the value reported by Gülter (2011) for Kasar whey powder sample. The differences between the whey powder were found to be statistically significant ($p<0.05$).

Total dry matter contents were similar and between 91.70 and 93.08% in all types of whey powder samples. Gülter (2011) reported similar result in the value of total dry matter. There were no statistically significant differences between the whey powder samples ($p> 0.05$).

The mean fat content of Kasar whey powder was found to be higher than those of Beyaz and Tulum whey powders. Gülter et al. (2011), who studied chemical properties of Kasar whey powder, found the mean levels of fat to be between 14.18-36.08%. The differences between the whey powder samples were determined to be statistically significant ($p<0.05$).

Average protein values in whey powders of this study were 9.30% for Beyaz whey powder, 13.28% for Kasar whey powder and 14.33% for Tulum whey powder. Protein contents by Uraz et al. (1990) and Gülter (2011) were to be higher than our findings. There were significant differences in protein values ($p<0.05$).

Higher content of ash was found in Beyaz whey powder (10.67%) than Tulum whey powder (8.80%) and Kasar whey powders (6.69%). Ash content in kasar whey powder was

found in the range of 6.29 to 11.57% by Gülter (2011). The differences between the whey powder were found to be statistically significant ($p<0.05$).

CONCLUSIONS

In this paper, chemical composition of freeze drying whey powders obtained from Beyaz cheese, Kasar cheese and Tulum cheese were investigated. Whey powders obtained from Beyaz, Kasar and Tulum cheeses were determined in the class of full-fat whey powder according to TS 11860-whey powder standard. In addition, whey powder obtained Beyaz cheese was found in the class of protein whey powder and whey powder obtained Kasar and Tulum cheeses were found in the class of high-protein whey powder according to TS 11860-whey powder standard. The difference in pH, titratable acidity, fat, protein and ash contents was found to be significant ($p<0.05$), while the differences in total solid values were not significant ($p> 0.05$) in the statistical analyzes.

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